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The 2009 H1N1 influenza A "swine flu" virus presentation in Virginia 2009

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Master of Public Health Research Project

The 2009 H1N1 influenza A "swine flu" virus presentation in Virginia 2009 (compared to seasonal influenza)

by

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Abstract

Objective: 2009 H1N1 influenza was first detected in the Northern Hemisphere in April 2009. National data have suggested that the novel influenza virus disproportionately causes severe illness in children and young adults, a somewhat different presentation from traditional seasonal flu which normally strikes hardest in the very young and older adults. This may or may not be the case in Virginia, which, if it is different, may suggest a need to alter flu prevention messages and vaccine policy as the outbreak continues through the fall 2009-10 influenza season. This report examined the early presentation of the new influenza virus in Virginia, compared with the seasonal flu presentation.
Methods: Surveillance data of influenza-like illness (ILI) visits to hospital emergency departments and urgent care centers for the period Oct. 2008 to Aug. 2009 were obtained from the Virginia Department of Health. The period from Oct. 2008-March 2009 was considered to be the normal flu season, while April-Aug. 2009 was considered as the 2009 (novel) H1N1 flu season. Descriptive statistics looked for differences by age, region and sex with respect to the proportion of visits that were for influenza-like illness compared to all reported illness for the normal and H1N1 flu seasons. Chi square and p-values were used to assess the level and significance of differences between flu seasons.
Results: While the 2009 H1N1 influenza was a novel virus that, like all influenza viruses, could mutate and change into a form causing more severe illness, during the early months of the epidemic/pandemic, the virus did not appear to cause more illness as a percent of all illness compared to the preceding months of influenza in Virginia. Though it was unexpected to have influenza-like illness in the amount seen during April-August 2009, with several exceptions the level of flu-like illness compared to all illness was not higher than during the normal flu season immediately preceding the appearance of the 2009 H1N1 influenza.
Conclusion: During the early months of the novel influenza H1N1 epidemic/pandemic in Virginia, the novel influenza virus caused levels of illness that were lower than levels of illness seen during the preceding normal flu season. Further study that examines the novel influenza virus through the end of the 2009-10 season may help to quantify the impact of the new virus. Flu-like illness reports spiked, for instance, as schools and colleges returned for fall 2009 semesters.

Introduction

Background

Novel influenza A/H1N1 2009, also called pandemic 2009 H1N1 influenza and informally "swine flu," was first detected in the Northern Hemisphere in April 2009. [1] In a matter of weeks the virus, facilitated by the ease of international travel, spread across the globe.[2,3] The World Health Organization on June 11, 2009 declared the start of a worldwide outbreak of influenza – a flu pandemic. [4] In the subsequent months, the world faced the threat of a novel version of an unpredictable virus that initially presented with seemingly mixed virulence – mild as the initial cases appeared in the United States, or more deadly, [5] as was suggested by the experience in Mexico where an April 23 report suggested that a cluster of cases in Mexico City sickened 120 people and killed 13. [6] Only time would tell.

Newspaper reports identified the index case as Maria Adela Gutierrez, 39, a mother and wife who worked as a door-to-door census-taker in Oaxaca, in Oaxaca state in southern Mexico.[7] Gutierrez became ill in early April and was initially diagnosed with a throat infection. Even though ill, she continued to work. As she continued to work, it's estimated she came in contact with as many as 100 to 300 people until ceasing to work just prior to the Easter holiday break. [7, 8]

Gutierrez's condition worsened and she was admitted to a hospital on or around April 8. Early lab tests suggested she had a coronavirus, the type of highly contagious virus implicated in the 2003 outbreak of severe acquired respiratory syndrome (SARS) that sparked international concern. [9] At the hospital where Gutierrez was treated, health officials began taking infection control actions. Later tests indicated it was not a coronavirus, but something equally disconcerting. She died April 13. Tests determined Gutierrez died from complications caused by a never-before-seen strain of a swine-origin influenza A. Hospital and local health officials began to take measures to identify people who might have been exposed. In the interim, a local newspaper had learned of unusual infection control procedures taking place at the hospital and sent reporters to investigate. [9] On April 16, health officials went public with their concerns. Those media reports of the situation at the state-run Dr. Aurelio Valdivieso General Hospital came to the attention of the World Health Organization.

On April 17, 2009, the World Health Organization requested verification of a report of a case of an atypical pneumonia in Oaxaca. [1] Two days later, April 19, the WHO notified Mexico of similar cases occurring in California. [1] The U.S. Centers for Disease Control and Prevention on April 21, 2009 issued an MMWR Early Release edition that described two cases it had learned of on April 17 of two children, sick with fever, who appeared to be infected with a novel strain of an swine influenza A (H1N1) virus that had not been seen before in humans or swine. [10] That report said:

> Although this is not a new subtype of influenza A in humans, concern exists that this new strain of swine influenza A (H1N1) is substantially different from human influenza A (H1N1) viruses, that a large proportion of the population might be susceptible to infection, and that the seasonal influenza vaccine H1N1 strain might not provide protection. The lack of known exposure to pigs in the two cases increases the possibility that human-to-human transmission of this new influenza virus has occurred.

Normally the federal public health agency receives reports of 1 to 2 cases a year of humans infected with a swine-origin influenza. Between 2005 and 2009 there were 11 such cases reported, but there were probably more that went undetected and unreported. [3] Historically, swine-origin influenza has been the subject of a significant amount of scholarly research. It's transmission to humans, particularly farm workers and their families had been studied by Christopher W. Olsen et al., whose 2002 research examined infection in farm workers and their families [11], and by Gregory C. Gray et al. who asked “Pandemic Influenza Planning: Shouldn't

Swine and Poultry Workers Be Included?" [12] Scholars have raised concerns about the role of swine viruses as potential factors in a pandemic influenza. [13]

As reports surfaced the index of suspicion was raised, and more suspected cases were reported. First references to the cases on ProMed, an internationally distributed and publicly available listserv run by the International Society for Infectious Diseases, were on April 24, according to the ProMed archives. [14] The listserv, available on the Internet, presented a translated version of a story in the April 23 edition of the Mexican newspaper *El Manana* that quoted an official of a union of health workers saying as many as 500 health sector workers were ill with influenza. Also, that day's mailing list forum includes a submission about Canadian health authorities on April 23, 2009 issuing an alert to doctors and hospitals to be on alert for patients with unusual flu-like symptoms whose history includes recent travel to Mexico. [14] In subsequent days, some countries would ban travel to Mexico, cruise lines canceled stops in Mexico, and some countries banned pork imports. [15]

By June 11, 2009 when the WHO declared that a pandemic had started, the novel influenza A virus had been reported in 74 countries with at least 30,000 people sickened. [1, 4, 16]

Global surveillance and epidemiological investigation suggested the never-before-seen spread rapidly but to be similar to a seasonal flu in terms of morbidity. [17] Over the next months the novel virus would prove itself to be very different in other ways from seasonal flu – affecting the young more than older populations and continuing to infect and spread during the warm months in the Northern Hemisphere. [17] Those were ominous signs, bringing to mind the flu pandemic of 1918 that killed at estimated 21 million-50 million worldwide. [18]

Influenza in historical context

Influenza, commonly referred to as "flu," is a respiratory viral infection that affects humans, birds, pigs and other animals. [19] Some researchers suggest that some of the earliest historical descriptions of influenza are in the pre-Christian era. Dobson and Carper write that "Hippocrates (460-377 B.C.) was probably the first person to record diseases with enough precision for them to be identified today as malaria, mumps, diphtheria, tuberculosis, and perhaps influenza." [20]

Influenza infection typically causes respiratory illness with symptoms of cough, sneezing, sore throat, fever and muscle aches. [21] Flu viruses continuously circulate in humans, birds, pigs, horses and other animals. Pigs have been called flu "mixing vessels" because they can be infected with human, avian (bird) and swine flu viruses. Those viruses can mix together and create new flu strains. [22]

The 2009 H1N1 influenza virus appears to be a mix of existing swine flu viruses, including a strain that has genetic pieces of swine, bird and human flu viruses. [23, 24] Because the swine flu virus genes were identified first, it was labeled a swine influenza. The novel H1N1 virus, however, was not known to be circulating in pigs in the United States at and around the time it was identified. [25] However in May 2009, the Canadian Food Inspection Agency said it had found the new virus in a swine herd in Alberta, suspecting the herd was exposed by a Canadian who had traveled to Mexico. [26]

Person-to-person virus transmission in humans is typically from exposure to virus-containing droplets expelled when a person coughs or sneezes.[21] Influenza virus, some reports suggest, can survive for 24 hours on plastic or metal surfaces, [27] so that a person does not necessarily have to be in close contact with an ill person to be exposed when virus is left on surfaces.

Vaccination, antiviral drugs and nonpharmaceutical interventions (NPIs) are the methods of reducing disease and transmission. [28] NP infection control methods that have been proven to reduce spread of infection include isolating sick persons away from others (isolation) and frequent hand washing to remove viral particles picked up from contact with contaminated surfaces (hand hygiene).[29] In some instances, quarantine – keeping people who have been exposed but who have not yet displayed symptoms – has been used. To reduce the spread of influenza, public health campaigns have emphasized the importance of cough and sneeze etiquette, i.e. covering one's sneeze or cough with a tissue, and if that is not available, sneezing into one's sleeve. Those practices reduce droplet contamination of surfaces, which has been shown to have merit in reducing spread of respiratory infections. [30, 31] In addition, methods such as social distancing (closing schools and canceling events to reduce personal contacts) and wearing face masks also have a role in preventing virus transmission in certain circumstances. [28]

Annually in the United States, seasonal flu and flu complications kill an estimated 36,000 people. [32] Globally, it's more difficult to estimate influenza morbidity and mortality because many developing countries do not have laboratory capability needed to do testing. [33] However, the World Health Organization estimates that annual seasonal flu epidemics worldwide "result in about three to five million cases of severe illness, and about 250,000 to 500,000 deaths." [34]

In modern times, documented worldwide flu outbreaks or pandemics include a 1957–1958 "Asian flu, a 1968 "'Hong Kong flu," a 1977 "Russian flu" and the most notorious of them all, 1918 "Spanish flu" pandemic. [5, 35] Of those, the 1918 flu pandemic was the most deadly, a pandemic of astronomical proportions the likes of which have not been seen since. People all over the world succumbed. Globally, it is believed as many as 21 million to 50 million died.

"The 1918–1920 H1N1Spanish Flu, which killed 40 million people worldwide is informative as a 'worst case scenario' for a flu pandemic," writes Derek Gatherer in the Journal of Clinical Virology. [35]

In the 1999 book *Flu*, science writer Gina Kolata writes:

> "Estimates range from 20 million to more than 100 million, but the true number can never be known. Many places that were bludgeoned by the flu did not keep mortality statistics, and even in countries such as the United States, efforts at tabulating the deaths were complicated by the fact that there was no definitive test in those days to show that a person actually had the flu." (page 7)

Taubenberger, Hultin and Morens describe the historical efforts to decipher the 1918 virus, including efforts that took researchers to Alaska in 1951 to retrieve tissues samples from long-ago flu victims buried in the Alaskan permafrost, which also served to preserve the tissues, and to afterwards try to grow the virus. Those efforts did not yield answers. Many years later, however, with improved technology that offered capabilities to analyze genetic material, scientists undertook a nine-year effort to complete the genetic coding sequence of the 1918 virus.[36] Tissues samples include formalin-fixed, paraffin-embedded (FFPE) autopsy tissues retrieved from a collection of the National Tissue Repository of the Armed Forces Institute of Pathology and samples recovered from another Alaskan expedition.

The efforts, described in a 2007 paper, conclude that:

> Viral sequence data now suggest that the entire 1918 virus was novel to humans in, or shortly before, 1918, and that it was not likely to have been a reassortant virus such as those that caused the 1957 and 1968 pandemics. Rather, the 1918 virus is an avian-influenza-like virus that appears to have been derived *in toto* from an unknown source because its eight genome segments differ from contemporary avian influenza genes, especially at synonymous sites.

More recently, Morens, Taubenberger and Fauci write that the "novel H1N1 virus associated with the ongoing 2009 pandemic is a fourth-generation descendant of the 1918 virus." The authors, which include the director of the National Institute of Allergy and Infectious Diseases at the National Institutes of Health, Dr. Anthony S. Fauci, add later that "The 1918 influenza virus and its progeny, and the human immunity developed in response to them, have for nearly a century evolved in an elaborate dance; the partners have remained linked and in step, even as each strives to take the lead." Their description suggests what experts are referencing when they state that influenza is unpredictable.

Indeed, it is influenza's unpredictability that makes it difficult to gauge preemptively how a flu season will unfold. The terms *drift* and *shift* describe influenza changes. [37] Drifts are more subtle changes. They may mean the vaccine developed for a seasonal flu does not offer as good protection as what was planned for because the virus changed in the six months it took to produce a vaccine. Shifts, on the other hand, are significant genetic changes in a viral subtype. Viral shifts are what spark pandemics.

As the 2009 pandemic continued unexpectedly during the warm summer months without retreat, it demonstrated that influenza is unpredictable and raised anew questions about prevailing beliefs of the epidemiology of influenza. In 2008, a team of researchers writing in *Virology Journal* described many of the incongruences of influenza, the virus's "bizarre epidemiology," as they put it, as described in the body of literature on influenza. Some of the questions they attempted to put in context include: where is the influenza virus between seasons, why is the secondary attack rate of influenza so low, why do epidemics end so abruptly, and why have influenza deaths in older people not declined despite the increase in vaccination rates? [38] The authors (including a lead author with ties to an agency promoting vitamin D, the so-called sunshine vitamin) suggest there is merit to the theories proposed by R.E. Hope-Simpson, who more than two decades ago suggested solar radiation and “intensely infectious” carrier-hosts important factors in the simultaneous, seasonal outbreaks of influenza. [39]

Surveillance

The propensity of influenza viruses to mutate is one reason for ongoing surveillance. When the U. S. Centers for Disease Control and Prevention, the agency “responsible for controlling the introduction and spread of infectious diseases,” reported on the first two U.S. cases of the 2009 pandemic influenza, there was also this comment that pointed out a level of uncertainty about the virus:

> This particular genetic combination of swine influenza virus segments has not been recognized previously among swine or human isolates in the United States, or elsewhere based on analyses of influenza genomic sequences available on GenBank. Viruses with this combination of genes are not known to be circulating among swine in the United States; however, no formal national surveillance system exists to determine what viruses are prevalent in the U.S. swine population. Recent collaboration between the U.S. Department of Agriculture and CDC has led to development of a pilot swine influenza virus surveillance program to better understand the epidemiology and ecology of swine influenza virus infections in swine and humans. [10]

As the epidemic/pandemic unfolded, there was more discussion about surveillance going forward. The CDC’s mission includes “active surveillance of diseases through epidemiologic and laboratory investigations and data collection, analysis, and distribution” [40]

States and some localities are the CDC’s partners in surveillance. At the Virginia Department of Health, the Office of Epidemiology’s Division of Surveillance and Investigation monitors “for the occurrence of reportable and emerging diseases or suspected outbreaks of illness (natural or otherwise), providing recommendations and guidance to prevent the spread of communicable diseases, and investigating outbreaks of disease and other public health emergencies."[41]

For collecting information on influenza, the Division uses several methods: laboratory reports, outbreak reports, and data on visits to hospital emergency departments and urgent care centers for influenza-like illness (ILI). For a normal flu season, data are collected year round, with a typical flu season beginning in October to correspond with the federal surveillance timeframe.

During the 2007-2008 influenza season, the department used additional methods as summarized in the paragraph below taken from a flu season summary:

> For the 2007-2008 influenza season, these data sources included: information on patients presenting to hospital emergency departments or urgent care centers with influenza-like-illness (ILI), laboratory reports of influenza positive specimens, information from outbreak investigations, reports of influenza-associated deaths in the pediatric population, and data on over-the-counter medication sales. A combination of these data were used to determine weekly influenza activity levels, summarize the length and severity of the influenza season, and characterize the prevalence of influenza types and strains throughout the season.[42]

Because the novel influenza A flu season initially represented as an unusual extension of the normal flu season into the summer months, surveillance took on an urgency as public health officials sought to get data on the virus and its epidemiology. See Appendix A for a synopsis of new and existing surveillance methods.

The Virginia Department of Health reported the first two cases of novel influenza A infections in Virginia on April 30, 2009.[43] The patients – an adult male from eastern Virginia and an adult female from central Virginia – each had traveled to Mexico. Both had mild illness and recovered. On June 2, 2009, the state health department reported the first novel H1N1 death in Virginia.[44] The patient, an adult female, lived at Southeastern Virginia Training Center, a facility for developmentally delayed persons that is operated by the state's Department of Mental

Health, Mental Retardation and Substance Abuse Services (The department name changed to the Department of Behavioral Health and Developmental Services on July 1, 2009). Virginia Health Commissioner Karen Remley, M.D., MBA, FAAP, on April 27, 2009 declared the state to be in a public health emergency in order to allow VDH additional means of communicating with health care providers as the situation unfolded. On October 24, 2009, President Barack Obama declared the H1N1 "swine flu" situation a "national emergency," a declaration that allows health care facilities to develop alternate plans to care for a surge of patients without having to petition the federal health agency to do so. [45, 46]

Objectives

The project examines data collected in Virginia during the 2008-09 normal flu season 2008-2009 and a subset of that season, the 2009 novel influenza A season to examine the human impact of the novel flu strain and to compare its epidemiological profile across influenza seasons. Data from previous influenza seasons are also included for comparison. National data have suggested that the novel influenza A has disproportionately caused severe illness in children and young adults, a somewhat different presentation from traditional seasonal flu which normally strikes hardest in the very young and older adults. This may or may not be the case in Virginia, which, if it is different, may need to alter flu prevention messages, vaccine policy, as the outbreak continues through the fall 2009-10 influenza season.

The purpose is also to consider influenza surveillance, how it is performed, how it is used and what it does and does not tell us. As the pandemic 2009 played out, health officials were often asked what would happen next. Often, the answer was along the lines that influenza is unpredictable, that this is what is known to this point, and that this is what we know from past influenza seasons.

Methods

This is a descriptive study, using data on influenza-like illness and all illness visits to health care organizations collected by the Virginia Department of Health through its syndromic surveillance program. This project examines surveillance data collected by VDH from October 2008 through August 2009. The period includes the October through March normal flu season in the Mid-Atlantic United States and the period we defined as the 2009 H1N1season--April 2009 through August 2009 during which the novel pandemic H1N1 influenza A surfaced and continued to cause illness throughout the warmer months when influenza typically dies down. In the Mid-Atlantic states, cases of influenza normally peak during the period of January to February.

The Virginia Department of Health Division of Surveillance and Investigation provided three Microsoft Excel spreadsheets with data on reports of influenza-like illness (ILI) and all visits to health care providers that are part of a syndromic surveillance and sentinel providers network for influenza surveillance. The data consisted of spreadsheets with data on:

●Visits to 24 urgent care outpatient centers and 57 hospital emergency departments in Virginia for influenza-like illness from the week ending Oct. 4, 2008 to the week ending Aug. 29, 2009. Variables included age group (0-4; 5-24; 25-49; 50-64; 65 and older), week of visit, gender and geographical region. (Numbers of facilities reporting by geographical region were 19 in Central, 32 in Eastern, 14 in Northern, 5 in Northwest, and 11 in Southwest. A total of 2,328 line records were in the database.

● Total visits for all types of illness to 24 urgent care outpatient centers and 57 hospital emergency departments from the week ending Oct. 4, 2008 to the week ending Aug. 29, 2009. Variables included age group, week, gender and geographical region. This spreadsheet contained a total of 2630 line records, and because the data were aggregated, there was no identifiable patient data.

● Weekly totals for visits to urgent care centers and hospital emergency departments for influenza-like visits for the weeks ending October 2008-August 2009. A total of 48 line records corresponding to weeks in the reporting time frame.

Case definition for ILI is fever along with a cough and/or a sore throat.

Because the data were aggregated by age group, there was no information on individual patients so approval from university ethics and patient protection committee was not needed.

Additionally, reports on the epidemiology of previous influenza seasons in Virginia were obtained from the VDH Web site.

Analysis was done using JMP Statistical Discovery Software, version 8.0.1 and Microsoft Excel 2007. The syndromic surveillance data were examined for differences in illness by week of visit, age group, region and gender. To test for difference and statistical significance we used percent differences, chi square and p-values. Using JMP we calculated there was sufficient sample size to detect a statistical difference if there was one.

As VDH continued to provide surveillance updates during the ongoing 2009-10 influenza season on the VDH Web site, some of those general findings are incorporated as indicated.

Results

The overall level of influenza-like illness visits to emergency departments and urgent care centers as a percent of all illness was lower during the H1N1 flu season compared to the normal flu season (Table 1). Patients captured in the surveillance network during the normal flu season were more likely to have complaints of ILI than during the H1N1 flu season. (OR 1.29 , 95% CI: 1.27,1.31)

There were noticeable spikes in ILI visits during May and June as H1N1 emerged, but peak numbers were below those during normal flu season. (Fig. 1) Stratified by age, sex and region, ILI visits were also generally lower during the H1N1 season than normal flu season, and the differences between the seasons were statistically significant. (Table 2) An exception to the trend of lower illness in the H1N1 season was in the Northern region, where ILI proportion was greater during H1N1 season, with that difference deemed statistically significant. (p value = 0.0000) Fig. 2a and Fig. 2b show that the Northern region accounted for a larger percentage of ILI illness during the H1N1 season than during the normal season.

Looking at age group differences by region, ILI levels were typically lower during the H1N1 flu season compared to normal flu season. (Table 3) The 65 and older age group in Central, Northern and Northwestern regions experienced similar levels of illness during both seasons. In addition, illness levels were similar between flu seasons in the 0-4 age group in the Northern region and in the 25-49 age group in the Northwestern region. Overall, percentage of illness accounted for by age groups during each of the flu seasons was similar. (Fig. 3) However, the differences shown in Fig. 3 look bigger than the differences reported in Table 2 so are probably statistically significant.

Level of illness was lower overall for both males and females during the H1N1 flu season (Table 4), with those levels significantly different from the normal flu season. An exception is males aged 65 years or older, where illness levels appear to be similar across flu seasons. Looking at regional differences by gender, ILI levels were lower for both sexes in all regions except for the Northern region where ILI reports were higher for both males and females in the

H1N1 season compared to the normal flu season. Overall, males and females accounted for similar percentages of ILI visits during both flu seasons. (Fig. 4)

The state also looks at ILI compared to a region specific baseline for ILI--the mean percentage of patient visits for ILI during non-influenza weeks for the previous three seasons plus two standard deviations. The baseline for Virginia and other south Atlantic states is 2.2 percent. A chart graphing ILI by week from Oct. 2008 through October 2009, shows percent of ILI visits peaked the fourth week of February, there were peaks during the warm months (May and June) and by October 2009, percent of illness was at its highest for the previous 12 months, with ILI representing about 15 percent of all visits to urgent care centers and hospital emergency rooms. (See Appendix B)

The very large sample size made it more likely that the study would detect differences.

Discussion

Reports of influenza-like illness were higher during the normal flu season of October 2008 through March 2009 compared to reports of ILI during the 2009 H1N1 influenza season of April-August 2009. However, as a new strain of flu never before seen in humans the 2009 H1N1 influenza virus was cause of significant public health concern worldwide. This study provides an early look at the presentation of H1N1 season in Virginia, stratifying results by age group, region and gender. ILI activity was present during warmer months (April-August 2009) when influenza typically dies down. Levels of ILI were frequently above the national seasonal baseline of approximately 2.4 percent of all visits during the early 2009 H1N1 flu season. (Fig. 1b) Health officials were particularly concerned that the 2009 H1N1 virus was causing more illness in younger age groups than what is seen during normal flu season. These results show higher levels of ILI visits as a percent of all visits during the normal flu season than during H1N1 season for all age groups. The results also show that within flu seasons, illness in the 0-4 age group was a smaller proportion or all illness during the H1N1 season than during normal flu season, while illness in the age groups 5-24 and 25-49 accounted for similar proportions of ILI within the normal and 2009 H1N1 flu seasons.

Prior to and in response to the novel H1N1 influenza A virus, public health officials added/included other surveillance methods to get a complete picture of influenza in the Commonwealth. Appendix A shows VDH surveillance methods and lists federally recommended surveillance methods, including some new efforts added as a result of the pandemic threat.

These results offer an early snapshot of 2009 H1N1 in Virginia, but conclusions to be drawn from the data are limited by several factors. First, we looked at ILI reports for April-August 2009 as the 2009 H1N1 season, while later reports show illness levels rising significantly several months after our study period ended.

Another major limitation of this study is the case definition for influenza-like illness is perhaps overly broad, and may capture other illness that is not influenza but that has similar symptoms. Australian researchers, for instance, found fever, cough and fatigue to be a better identifier of flu cases. [47] In the *British Medical Journal*, a clinician asks the question "Is the case definition too loose," pointing out that of the throat swabs taken from a group of 20 patients labeled as having 2009 H1N1 flu, only two tested positive.[48] ILI data, however, are not meant to identify every person with influenza because it is widely understood that many people who are sick self-treat and do not seek medical care. Rather, according to VDH, surveillance is used to monitor changes in flu activity from week to week. There is no precise way to know for certain how much ILI is in a community. However, that raises the question of whether there is need for spot checking or audits of ILI reports to get estimates of the accuracy of ILI reports.

Other agencies trying to track influenza note similar limitations in surveillance methods. A surveillance effort of the American College Health Association is tracking influenza at colleges and universities. According to ACHA data, attack rates reached 20 percent at some universities by mid-October. [49] (See Appendix D) However, the researchers note the limitations of the surveillance data, including that it represents only those institutions that participate in the surveillance program.

Influenza testing limitations add to the dilemma of quantifying level of illness in a community. It is neither practical nor cost effective to test every person sick with a fever, cough and sore throat. In addition, rapid tests for the H1N1 virus that are available in urgent care centers and hospital emergency departments are not the best predictors of influenza. A Centers for Disease Control and Prevention review found rapid tests to have a sensitivity of 40%-69%. [50] That report, which looked at cases in outbreaks in schools in Connecticut, found that the rapid tests correctly identified less than half the cases confirmed by viral culture and real-time reverse transcription--polymerase chain reaction (rRT-PCR) as H1N1 influenza. Other research found similar shortcomings of the tests. Writing in the journal, *Clinical Infectious Diseases*, Vasoo et al. found the sensitivities of three rapid influenza antigen tests for H1N1 "low to moderate," specifically they noted the following tests had the sensitivity indicated: BD Directigen EZ Flu A+B test (Becton Dickinson), 46.7%; BinaxNOW Influenza A&B (Inverness Medical), 38.3%; QuickVue Influenza A+B Test (Quidel), 53.3%. [51]

That said, surveillance is continuously evolving in new and creative ways. Some of the more atypical efforts to track flu outbreaks have consisted of collecting data on purchases of over-the-counter cold medications and monitoring ambulance calls. [52-55] In addition, enterprising efforts have sought to identify outbreaks before they become available by conventional surveillance methods through tracking how often people search for the terms influenza, cough, fever, etc. using Web-based search engines. Hulth et al. analyze such efforts with the premise that conventional surveillance methods that rely on sick people seeking care have limitations. Methods that rely on hospital and other provider data, the Swedish researchers note, “demand that the cases seek medical care, and there may be an over-representation of groups that are vulnerable for severe disease in the reporting.” [56] In addition, the authors state that during a pandemic, like the one occurring as this paper is written, “There is also a risk that the sentinel system collapses during a pandemic, since the health care staff will be overloaded with patient care.” Their study suggested Web-query data can provide a 7-10 day advance notice of flu outbreaks ahead of the traditional methods.

U.S. and other researchers have also explored the validity of Web search engines as a surveillance tool. [57-60] According to Carneiro et al., Google Flu Trends is unique and innovative technology that “takes us one step closer to true real-time outbreak surveillance.” [57] Eysenbach presenting at a symposium in 2006 noted that there is a correlation between numbers of clicks on key words in Google with epidemiological data from the flu season 2004/2005 in Canada .[61] In fact, concluded Eysenbach, the Google method “proved to be more timely, more accurate and… considerably cheaper than the traditional method of reports on influenza-like illnesses observed in clinics by sentinel physicians.” Google Flu Trends expanded to 14 countries in Europe on October 8, 2009. [58]

The ongoing need for surveillance is evident. Experts have in recent years suggested that the world was overdue for an influenza pandemic based on the cyclical nature of worldwide flu outbreaks. [62] Surveillance provides a way to identify possible pandemic strains early, and perhaps get a head start on preparing a counterattack. That has not always been possible.

Tognotti describes the first documented worldwide influenza outbreak as perhaps occurring in 1580, originating in Asia and described by observers as like a "wind illness" because of how quickly and easily it spread. [63]

"Since the last pandemic nearly 40 years ago, we have observed dramatic changes in social and ecological factors thought to facilitate emergence of a pandemic-capable strain," noted Mills et al. in 2006. [64] Whether a pandemic virus would emerge from a swine or avian influenza strain was uncertain. The 1976-77 "swine flu" affair that caused an outbreak in recruits stationed at Fort Dix, New Jersey, described by Gaydos, [65] raised the profile of swine-origin influenza viruses as possible pandemic strains. Writing in the journal *Virus Research* in 2002, Christopher W. Olsen noted that for many years H1N1 influenza was the predominant type circulating in pigs, but in recent decades H3N2, H1N2 and H4N6 subtypes had been identified in pigs. [22] Much of the international concern, however, seemed to be centered on avian influenza viruses sparking the next influenza pandemic. Of specific concerns was the H5N1 avian influenza, a highly virulent form that came to public notice in 2004 when it caused deaths in the Asian countries of Thailand and Vietnam, wrote researchers summarizing the proceedings of a global workshop on pandemic preparedness. [66] The report's authors note:

> "The past decade has seen increasingly frequent and severe outbreaks of highly pathogenic avian influenza…The current ongoing epidemic of H5N1 avian influenza in Asia is unprecedented in its scale, in its spread, and in the economic losses it has caused."

Internationally, the Global Influenza Surveillance Network (GISN) – consisting of five World Health Organization collaborating centres (WHOCC) for reference and research, four essential regulatory laboratories (ERLs), and 128 institutions in 99 countries recognized as national influenza centres (NICs) – is the primary source for getting a global picture of the patterns and behavior of influenza viruses. [67] Much of that data is brought together in FluNet, a

Web-based reporting system that allows searching for influenza reports by country, WHO region and continent. [68] Appendix C contains a sample report, which makes it apparent that flu reporting varies by country.

Conclusion

Influenza-like illness is not influenza. Respiratory and other illnesses such as colds, respiratory syncytial virus, and strep throat have similar symptoms. Media coverage of the 2009 influenza pandemic may be driving people to urgent care centers and emergency rooms who might in a more normal year take a wait-and-see approach to treating influenza. Flu surveillance offers a snapshot of what is happening in the community—tracking ILI, laboratory specimens, hospitalizations, deaths and more.

Many issues have been highlighted by the 2009 pandemic episode. They include vaccine production and policy for patient prioritization, interaction between those doing surveillance of influenza in humans and those doing surveillance in animals, influenza testing protocols and the case definition of influenza, defining a pandemic, and communicating prevention messages. Vaccine production by late October was not meeting projections, adding to the sense of urgency and concern with the new-to-humans influenza. As with past flu seasons when there was a shortage of vaccine, demand appeared to increase. Currently, most influenza vaccine is produced in chicken eggs. That system is time-consuming, and as this episode may or may not show eventually, vaccine may not make it to communities in time to prevent peak illness. Ideally, vaccine would be produced using cell culture technology and there would be a universal flu vaccine that protected against all strains of the virus.

This study suggests that influenza surveillance systems are better developed in some areas of the state, with more reporting from some regions, giving the appearance of more illness when one cannot be sure that is, in fact, the case. At this writing, this episode of pandemic flu is not over, with months to go before the flu season ends. Much is being written about what needs to happen going forward. Globally surveillance programs are needed to more broadly detect what some call zoonotic "hotspots." Mexico was not the place expected to give rise to a pandemic flu strain. And there has been criticism that reporting was slow, possibly out of concern for economic considerations. Much of the focus had been on avian flu and Southeast Asia as the more likely place for origination of a pandemic virus. Leibler et al., however, suggest domestic animal protection farms in many places across the globe create artificial environments ripe for creation of new zoonotic pathogens, and they offer that:

> "The importance of early detection cannot be overstated, as the magnitude of disease epidemics is exponentially related to the time elapsed between pathogen introduction and implementation of control measures. Timely reaction heavily relies on early detection and disclosure by those in daily contact with food animals, however, current disease control policy tends to discourage this behavior."[69]

Thus, while the need for surveillance to monitor for new pathogens is important to public health, the economic risks to growers/farmers can be substantial if something is detected. Financial harm to farmers must be considered as a possible deterrent to reporting if surveillance programs are to be effective. Throughout the swine flu outbreak the pork industry has had to go on the counteroffensive to assure customers that one cannot get swine flu from eating pork.[70] Similarly, with the avian or bid flu scare several years ago, the poultry industry faced the same need to dispel rumors about eating chicken.[71]

While the term *pandemic* may suggest something far worse than what is occurring (i.e., the 1918 flu pandemic), so far, the virus has remained stable, causing mild to moderate illness.

Kilbourne in 1997 wrote, “Based on our limited store of unequivocal evidence, we can forecast neither the source, the life span, nor the severity of future pandemics. We must be prepared, not only for variations on these past themes, but for ones the virus has not yet exhibited. But we must be prepared for the worst case, which is a double antigen change combined with increased virulence.”[72]

Epidemiological surveillance provides data needed to make sound public health decisions during an infectious disease outbreak and can also suggest areas where additional research is needed before, during and after an episode. The 2009 influenza pandemic has tested the public health system, magnifying both strengths and weaknesses of measures to control spread of infectious diseases.

Tables

Figures

TABLE 1. Percent of ILI and All visits by normal and H1N1 flu seasons, Oct. 2008-Aug. 2009, Virginia.

Flu Season	**ILI**	**Non-ILI**	**All Visits**	**Percent of visits for ILI**	OR
Normal flu season (Oct. 2008-March 2009)	33,932	1,441,808	1,475,740	2.30	1.29
H1N1 flu season (April-Aug. 2009)	22,864	1,254,606	1277470	1.79	1
	56,796	2,696,414	2,753,210		

TABLE 2. Number of visits* for influenza-like illness (ILI) and all visits by normal (Oct. 2008-March 2009) and H1N1 (April-Aug. 2009) flu seasons by age group, sex and region, Virginia.**

		Oct. 2008-March 2009				April 2009-Aug. 2009					
		ILI visits	**Non-ILI visits**	**All Visits**	**% of Visits for ILI**	**ILI visits**	**Non-ILI visits**	**All Visits**	**% of Visits for ILI**	**chi square**	***p-value***
Age (yrs)	0-4	7,079	124,698	131,777	(5.37)	4,338	95,170	99,508	(4.36)	123.86	0.0000
	5-24	12,507	342,738	355,245	(3.52)	8,603	301,307	309,910	(2.78)	298.71	0.0000
	25-49	10,411	539,911	550,322	(1.89)	7,069	478,314	485,383	(1.46)	294.44	0.0000
	50-64	2,739	226,308	229,047	(1.20)	2,007	201,707	203,714	(0.99)	44.10	0.0000
	65+	1,196	208,153	209,349	(0.57)	847	178,108	178,955	(0.47)	17.70	0.0000
Sex	Female	18,607	822,464	841,071	(2.21)	12,581	708,578	721,159	(1.74)	434.16	0.0000
	Male	15,299	613,347	628,646	(2.43)	10,269	541,114	551,383	(1.86)	452.18	0.0000
Region	Central	9,237	382,262	391,499	(2.36)	5,569	323,624	329193	(1.69)	396.18	0.0000
	Eastern	14,654	565,406	580,060	(2.53)	9,186	475,802	484,988	(1.89)	482.47	0.0000
	Northern	4,759	241,547	246,306	(1.93)	5,509	232,092	237,601	(2.32)	86.96	0.0000
	Northwestern	1,336	115,000	116,336	(1.15)	922	104,511	105,433	(0.87)	41.17	0.0000
	Southwestern	3,923	137,616	141,539	(2.77)	1,656	118,599	120,255	(1.38)	606.29	0.0000

*Visits are those made to hospital emergency departments and urgent care centers that are part of the Virginia Department of Health surveillance network.
**Case definition of influenza-like illness is a fever with cough and/or sore throat.

TABLE 3. Percentage of visits for influenza-like illness (ILI) and all visits for normal flu season (Oct. 2008-March 2009) and H1N1 flu season (April-Aug. 2009), health region by age group, Virginia

		Oct. 2008-March 2009			April 2009-Aug. 2009				
Region	**Age group (yrs)**	**ILI**	**All visits**	**ILI as percent of All Visits**	**ILI**	**All Visits**	**ILI as percent of All Visits**	**chi-square**	***p* value**
Central	0-4	1,170	25,999	(4.50)	592	17,904	(3.31)	39.214	0.0000
	5-24	3,678	93,890	(3.92)	2,234	78,916	(2.83)	153.187	0.0000
	25-49	3,349	156,436	(2.14)	2,031	133,303	(1.52)	150.627	0.0000
	50-64	786	62,835	(1.25)	533	54,576	(0.98)	19.781	0.0000
	65+	270	52,339	(0.52)	201	44,494	(0.45)	2.043	0.1529
Eastern	0-4	2,681	52,575	(5.10)	1,659	38,860	(4.27)	34.063	0.0000
	5-24	5,373	145,593	(3.69)	3,537	123,448	(2.87)	175.111	0.0000
	25-49	4,750	216,585	(2.19)	2,840	184,195	(1.54)	227.257	0.0000
	50-64	1,327	91,799	(1.45)	826	77,965	(1.06)	50.192	0.0000
	65+	524	73,508	(0.71)	324	60,520	(0.54)	16.631	0.0000
Northern	0-4	1,776	31,282	(5.68)	1,494	26,997	(5.53)	0.563	0.4530
	5-24	1,486	53,878	(2.76)	1,868	54,075	(3.45)	43.475	0.0000
	25-49	1,032	89,242	(1.16)	1,510	87,813	(1.72)	99.195	0.0000
	50-64	293	36,577	(0.80)	446	36,250	(1.23)	33.405	0.0000
	65+	172	35,327	(0.49)	191	32,486	(0.59)	3.247	0.0715
Northwestern	0-4	426	11,335	(3.76)	189	7,735	(2.44)	25.467	0.0000
	5-24	469	27,976	(1.68)	322	24,608	(1.31)	11.961	0.0005
	25-49	291	40,261	(0.72)	288	37,637	(0.77)	0.474	0.4909
	50-64	105	17,187	(0.61)	76	16,854	(0.45)	4.119	0.0424
	65+	45	19,577	(0.23)	37	18,599	(0.20)	0.426	0.5141
Southwestern	0-4	1,026	10,586	(9.69)	404	8,032	(5.03)	139.992	0.0000
	5-24	1,501	33,908	(4.43)	632	28,863	(2.19)	237.090	0.0000
	25-49	989	47,798	(2.07)	400	42,435	(0.94)	188.207	0.0000
	50-64	228	20,649	(1.10)	126	18,069	(0.70)	17.606	0.0000
	65+	185	28,598	(0.65)	94	22,856	(0.41)	13.078	0.0002

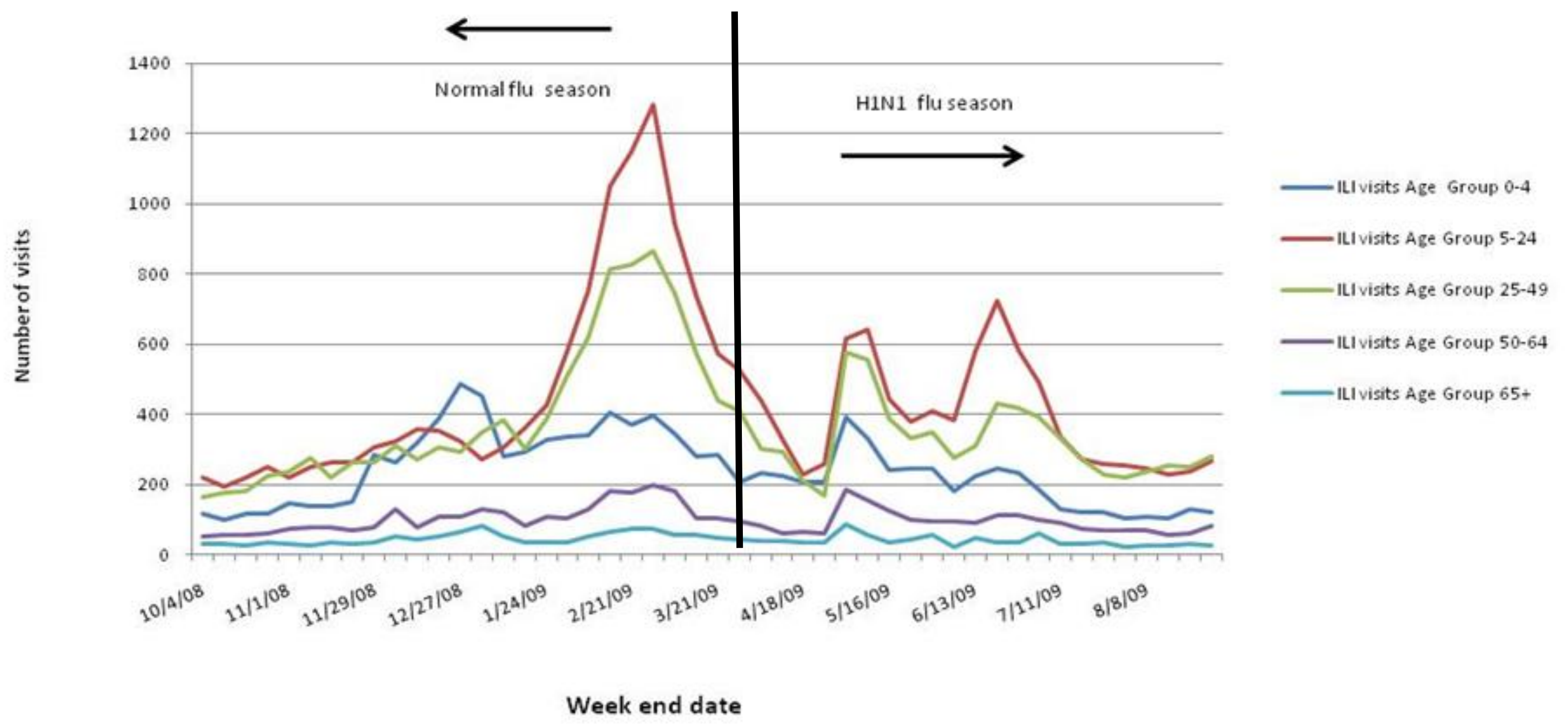
TABLE 4. Number and percent of visits for influenza-like illness (ILI) and all visits by normal and H1N1 flu season, sex by age group, Virginia.

		Oct. 2008-March 2009			April 2009-Aug. 2009				
		ILI visits	All Visits	ILI as percent of all Visits	ILI Visits	All Visits	ILI as percent of all Visits	chi square	*p*-value
Female	**Age (yrs)**								
	0-4	3,269	60,532	(5.40)	2,014	45,242	(4.45)	49.122	0.0000
	5-24	6,786	291,594	(2.33)	4,690	172,804	(2.71)	67.374	0.0000
	25-49	6,223	328,284	(1.90)	4,218	284,758	(1.48)	156.384	0.0000
	50-64	1,594	128,006	(1.25)	1,193	113,179	(1.05)	21.72	0.0000
	65+	735	122,655	(0.60)	466	105,176	(0.44)	26.352	0.0000
Male	**Age (yrs)**								
	0-4	3,810	71,241	(5.35)	2,324	54,261	(4.28)	75.157	0.0000
	5-24	5,721	153,646	(3.72)	3,913	137,097	(2.85)	170.894	0.0000
	25-49	4,187	222,016	(1.89)	2,850	200,605	(1.42)	131.286	0.0000
	50-64	1,145	101,032	(1.13)	814	90,526	(0.90)	25.854	0.0000
	65+	436	80,711	(0.54)	368	68,894	(0.53)	0.055	0.8143

TABLE 5. Number and percent of visits for influenza-like illness (ILI) and all visits by normal and H1N1 flu season, region by gender, Virginia.

		Oct. 2008-March 2009			April 2009-Aug. 2009				
Region	**Sex**	**ILI visits**	**All visits**	**ILI as percent of All Visits**	**ILI visits**	**All visits**	**ILI as percent of All Visits**	**chi square**	***p*-value**
Central	Female	5,098	222,691	(2.29)	3,159	185,863	(1.70)	177.9	0.0000
	Male	4,136	164,964	(2.51)	2,422	140,275	(1.73)	219.732	0.0000
Eastern	Female	8,175	339,278	(2.41)	5,197	281,569	(1.85)	232.087	0.0000
	Male	6,479	240,745	(2.69)	3,989	203,393	(1.96)	287.834	0.0000
Northern	Female	2,419	135,432	(1.79)	2,836	129,336	(2.19)	56.223	0.0000
	Male	2,340	110,702	(2.11)	2,672	108,114	(2.47)	31.267	0.0000
Northwestern	Female	705	64,551	(1.09)	480	57,537	(0.83)	21.053	0.0000
	Male	631	51,784	(1.22)	442	47,894	(0.92)	20.424	0.0000
Southwestern	Female	2,210	79119	(2.79)	909	66,854	(1.36)	356.137	0.0000
	Male	1,713	60451	(2.83)	744	51,707	(1.44)	253.050	0.0000

FIG. 1a. Number of influenza-like illness visits by age group, Oct. 2008-Aug. 2009, Virginia.



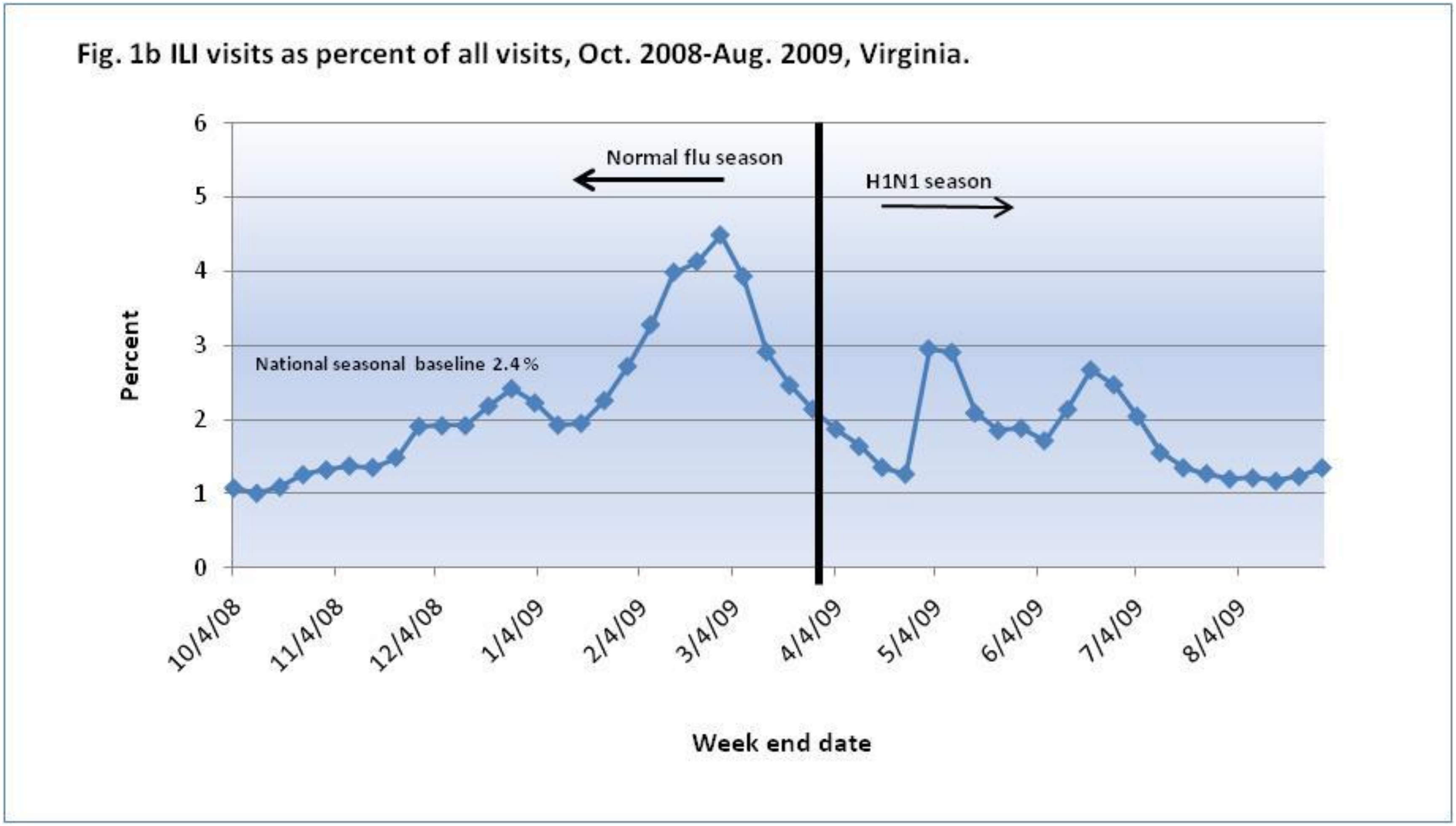


Fig. 1b ILI visits as percent of all visits, Oct. 2008-Aug. 2009, Virginia.
Normal flu season
H1N1 season
National seasonal baseline 2.4 %
Percent
0
1
2
3
4
5
6
10/4/08
11/4/08
12/4/08
1/4/09
2/4/09
3/4/09
4/4/09
5/4/09
6/4/09
7/4/09
8/4/09
Week end date

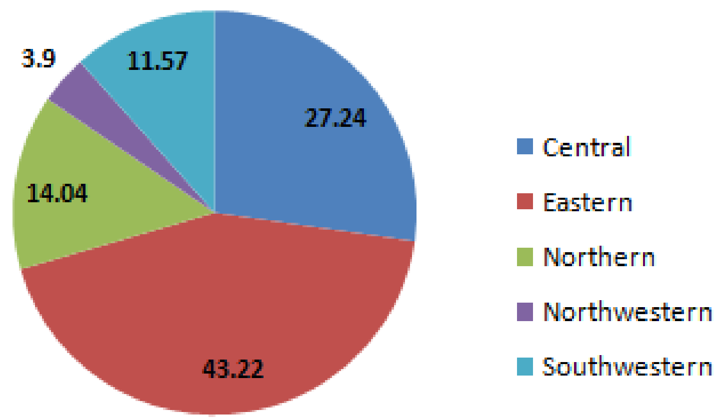


Fig. 2a Normal flu season (Oct. 2008-March 2009) Percent of ILI visits by Region, Virginia.

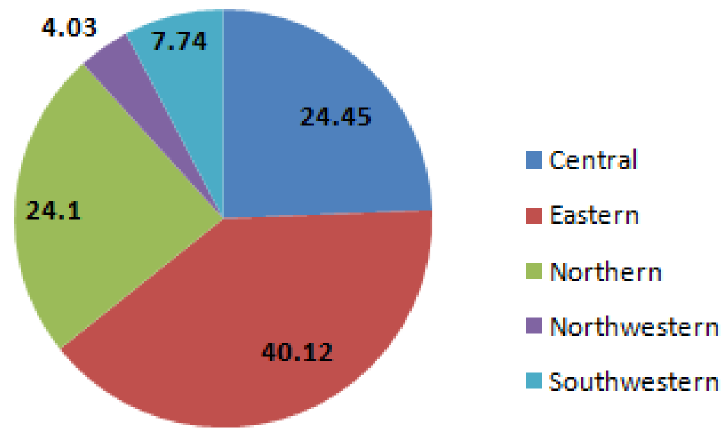


Fig. 2b H1N1 flu season (April-Aug. 2009) Percent of ILI visits by region, Virginia.

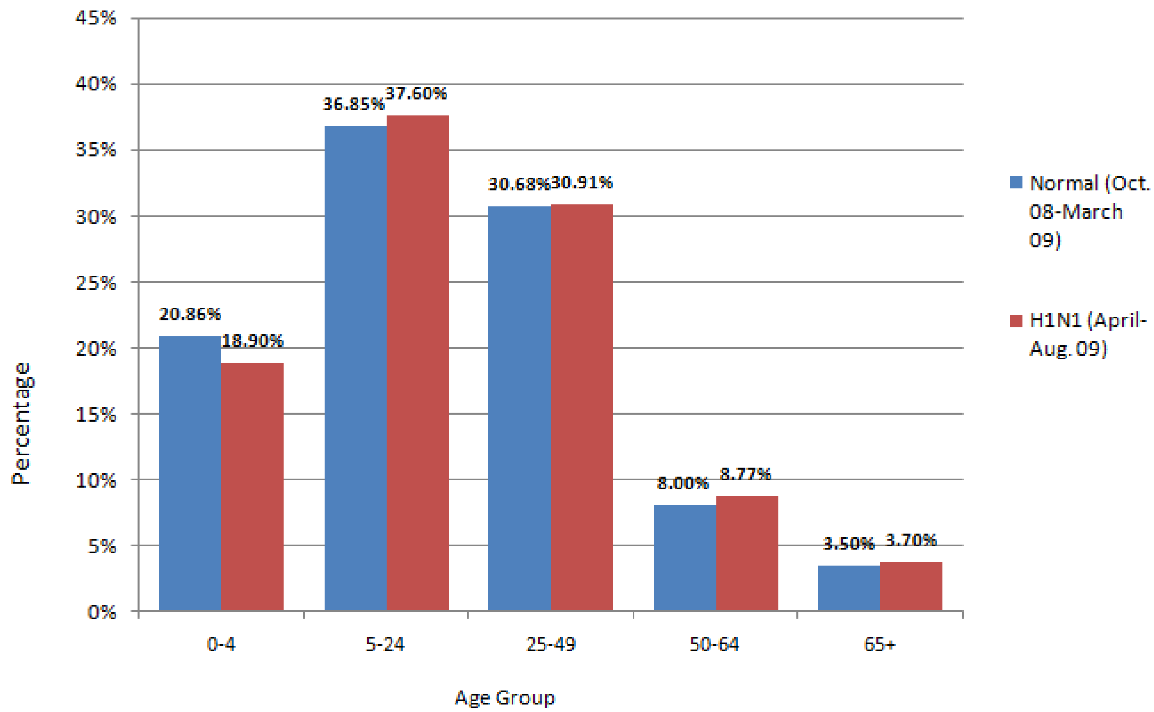


FIG. 3. Percent of influenza-like illness visits accounted for by age group during normal and H1N1 flu seasons, Virginia.

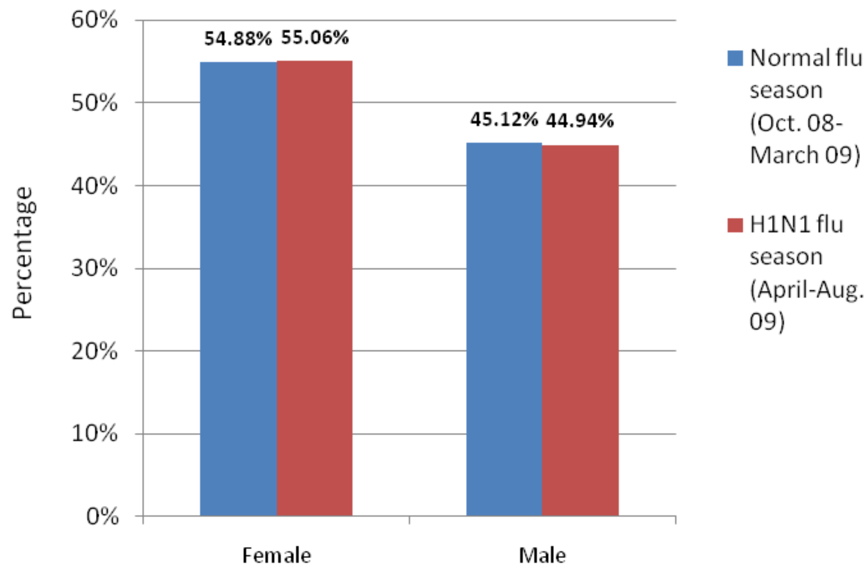


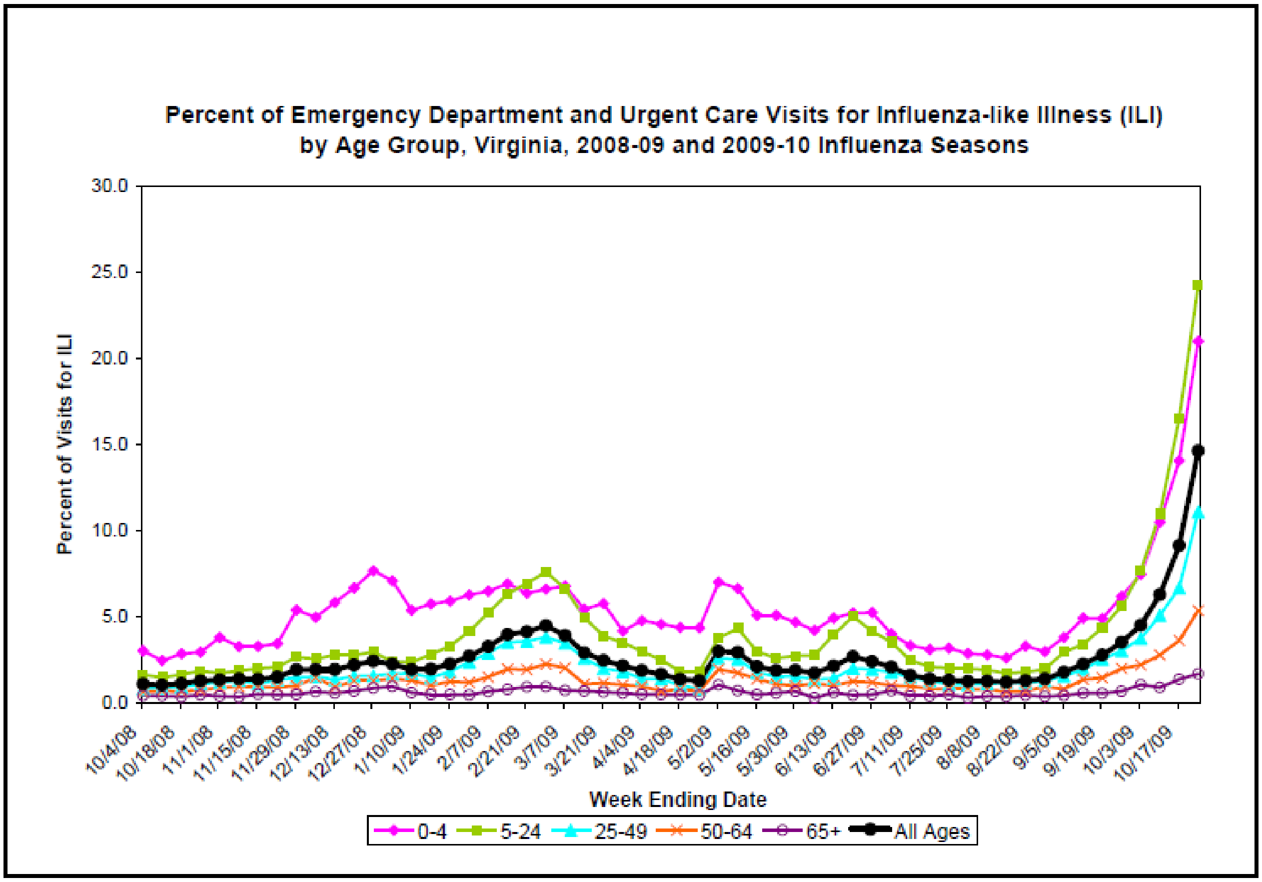
FIG. 4. Percent of influenza-like illness visits by sex during normal and H1N1 flu seasons, Virginia.

Appendices

Appendix A. Influenza Surveillance: Virginia and the Centers for Disease Control and Prevention

Method of Surveillance	***Virginia Department of Health***	**U.S. Centers for Disease Control and Prevention**
Influenza-like illness counts; chief complaint of fever and cough, or fever and sore throat, or mention of the flu	Automated syndromic surveillance data feeds from 57 emergency departments, 24 urgent care centers. Percent of visits by age group.	National network of 2,400 providers in 50 states. Each week reports from 1,300 outpatient providers on total number of patients seen and total with ILI (defined as temperature of 100 degrees F or higher; and cough or sore throat in the absence of a known cause other than influenza. Percentage of patient visits weighted by state population; this percentage compared weekly to national baseline of 2.4 percent. Regional baselines vary (Virginia's is 2.2 percent)
Influenza-associated deaths	Weekly counts of deaths certificates that mention influenza or pneumonia are tracked by location and age group	Vital statistics offices of 122 cities report total number of death certificates received and those that mention influenza or pneumonia by age group. An increase of 1.645 standard deviations above the seasonal baseline of pneumonia and influenza deaths is considered at epidemic level.
Pediatric influenza-associated deaths	Reportable disease by Code	Reportable disease since 2004
Outbreak investigation	Routine reminders to facilities to report outbreaks; specimens collected an analyzed by state-run DCLS.	
Passive surveillance	Counts reported by physicians	
Passive laboratory surveillance	Monitor lab-confirmed influenza specimens submitted through routine mechanism	
School absenteeism reports	Daily counts from schools of enrollment and absences of students, faculty, staff	
School closure reports	Schools report closures on CDC Web site; state can access that data	
Active laboratory surveillance from sentinel sites	Sentinel providers (physicians, emergency departments and urgent care centers) asked to provide 1 specimen per month per facility; ongoing efforts to recruit sentinel physicians	80 U.S. WHO Collaborating Laboratories and 70 National Respiratory and Enteric Virus Surveillance System laboratories, some county public health laboratories and some large medical centers reports numbers of specimens tested and number positive for influenza A and B. Human infection with a novel influenza A virus became a nationally notifiable condition in 2007.
Inpatient hospital	Sentinel hospitals provide 5 specimens per month; a hospital from each of the five health planning regions	Emerging Infections Program Influenza Project surveillance for influenza-related hospitalization in children and adults in 60 counties and 12 Metro areas of 10 states (CA, CO, CT, GA, MD, MN, NM, NY, OR, TN). Cases identified from hospital admission and laboratory databases and test results. Results reported every two weeks during flu season.
National Respiratory and Enteric Virus Surveillance System		
New Vaccine Surveillance Network		Hospitals in three counties (one in Ohio, Tennessee and New York) that are part of the New Vaccine Surveillance Network provide population-based estimates of laboratory-confirmed influenza hospitalization rates of children less than 5 years old.
Geographic Spread of Influenza Summary		State health departments report estimated level of flu activity. Levels are no activity, sporadic, local, regional and widespread.
Pneumonia and Influenza Hospitalization and Death Tracking		This new system was implemented on August 30, 2009, and replaced the weekly report of laboratory confirmed 2009 H1N1-related hospitalizations and deaths that began in April 2009. Jurisdictions report to CDC either laboratory confirmed or pneumonia and influenza syndromic-based counts of hospitalizations and deaths resulting from all types or subtypes of influenza, not just those from 2009 H1N1 influenza virus.
Antigenic characterization		Antigen characterization of influenza viruses began Sept. 1, 2009.
Antiviral resistance testing		CDC labs test influenza A (H1N1) virus isolates for resistance to the neuraminidase inhibitors (oseltamivir and zanamivir). Additional laboratories perform antiviral testing and report their results to CDC.

Appendix B.
http://www.vdh.virginia.gov/epidemiology/DiseasePrevention/H1N1/pdf/10-28-09Percent_ILI_Age.pdf



Appendix C. Sample FluNet report from http://gamapserver.who.int/GlobalAtlas/home.asp

Isolates Informations Report - By Continent

Summary

Continent	Week N°/Year	Total Number of Specimens Processed	Total Number of A(H1)	Total Number of A(H3)	Total Number of A Not Subtyped	Total Number of B	Total Number of Other
South America	Whole Selected Period	1376	20	53	5	4	18
Total	Whole Selected Period	1376	20	53	5	4	18

Detail per Country

Continent	Country	Year	Total Number of Specimens Processed	Total Number of A(H1)	Total Number of A(H3)	Total Number of A Not Subtyped	Total Number of B	Total Number of Other
South America	Argentina	2009	210	0	0	0	0	0
South America	Bolivia	2009	0	0	0	0	0	0
South America	Brazil	2009	732	18	26	5	3	18
South America	Chile	2009	0	0	0	0	0	0
South America	Colombia	2009	0	0	0	0	0	0
South America	Ecuador	2009	0	2	27	0	1	0
South America	French Guiana	2009	0	0	0	0	0	0
South America	Guyana	2009	0	0	0	0	0	0
South America	Paraguay	2009	0	0	0	0	0	0
South America	Peru	2009	434	0	0	0	0	0
South America	Suriname	2009	0	0	0	0	0	0
South America	Uruguay	2009	0	0	0	0	0	0
South America	Venezuela	2009	0	0	0	0	0	0

Detail per Period

Continent	Week N°	Year	Total Number of Specimens Processed	Total Number of A(H1)	Total Number of A(H3)	Total Number of A Not Subtyped	Total Number of B	Total Number of Other
South America	21	2009	594	2	9	0	3	1
South America	22	2009	403	8	11	3	0	7
South America	23	2009	202	10	17	2	1	10
South America	24	2009	93	0	14	0	0	0
South America	25	2009	58	0	2	0	0	0

Appendix D.

American College Health Association

TABLE - 1: Weekly College ILI Cases Reported for: Week Ending Oct 16

Reporting Institutions:	***278***		
Institutions w/New Cases:	***264***	***95%***	
Total New Cases:	***7,099***		
Population Served:	***3,397,011***		
New Case Rate:	***20.9 per 10,000***		
Percent Change From Previous Week:	***9%***		

HHS Surveillance Region	Total Regional Cases	State/Territory		New Cases	Reported Population Served	Attack Rate (Per 10,000 Served)	*Attack Rate % Change from Previous Week*
Region 1	303	Connecticut	CT	65	36,104	18.0	80%
		Maine	ME	.	.	-	-
		Massachusetts	MA	129	101,521	12.7	27%
		New Hampshire	NH	45	30,776	14.6	-53%
		Rhode Island	RI	42	27,656	15.2	5%
		Vermont	VT	22	21,624	10.2	16%
Region 2	640	New Jersey	NJ	169	120,216	14.1	-7%
		New York	NY	471	225,521	20.9	20%
		Puerto Rico	PR	.	.	-	-
		Virgin Islands	VI	.	.	-	-
Region 3	1,178	Delaware	DE	22	21,915	10.0	31%
		District of Columbia	DC	44	35,517	12.4	-46%
		Maryland	MD	202	79,253	25.5	9%
		Pennsylvania	PA	592	192,517	30.8	18%
		Virginia	VA	312	96,763	32.2	15%
		West Virginia	WV	6	1,800	33.3	50%
Region 4	1,251	Alabama	AL	12	27,100	4.4	-59%
		Florida	FL	336	292,903	11.5	-23%
		Georgia	GA	57	36,900	15.4	-22%
		Kentucky	KY	228	44,500	51.2	65%
		Mississippi	MS	49	41,200	11.9	-8%
		North Carolina	NC	324	145,547	22.3	13%
		South Carolina	SC	173	68,601	25.2	-16%
		Tennessee	TN	72	42,930	16.8	-9%
Region 5	1,231	Illinois	IL	161	84,207	19.1	33%
		Indiana	IN	494	97,182	50.8	115%
		Michigan	MI	108	125,850	8.6	-17%
		Minnesota	MN	202	54,575	37.0	48%
		Ohio	OH	133	87,807	15.1	25%
		Wisconsin	WI	133	87,354	15.2	41%
Region 6	498	Arkansas	AR	90	48,839	18.4	-31%
		Louisiana	LA	2	4,834	4.1	24%
		New Mexico	NM	68	26,000	26.2	-14%
		Oklahoma	OK	28	3,700	75.7	27%
		Texas	TX	310	181,235	17.1	-19%
Region 7	344	Iowa	IA	5	2,000	25.0	400%
		Kansas	KS	5	960	52.1	N/D
		Missouri	MO	259	75,200	34.4	-26%
		Nebraska	NE	75	17,538	42.8	29%
Region 8	566	Colorado	CO	369	147,843	25.0	12%
		Montana	MT	124	11,000	112.7	202%
		North Dakota	ND	.	.	-	-
		South Dakota	SD	34	1,900	178.9	278%
		Utah	UT	5	29,359	1.7	-50%
		Wyoming	WY	34	10,000	34.0	42%
Region 9	623	American Samoa	AS	.	.	-	-
		Arizona	AZ	163	89,000	18.3	-11%
		California	CA	440	373,707	11.8	-9%
		Fed. States of Micronesia	FM	.	.	-	-
		Guam	GU	.	.	-	-
		Hawaii	HI	.	.	-	-
		Marshall Islands	MH	.	.	-	-
		Nevada	NV	20	16,900	11.8	-57%
		Northern Mariana Islands	MP	.	.	-	-
		Palau	PW	.	.	-	-
Region 10	464	Alaska	AK	19	14,000	13.6	12%
		Idaho	ID	86	19,667	43.7	6%
		Oregon	OR	232	24,683	94.0	25%
		Washington	WA	127	58,100	21.9	55%
Outside U.S.	1	Outside the United States	ZZ	1	12,707	0.8	-50%
TOTALS	**7,099**			**7,099**	**3,397,011**	*(N/D = no cases reported in previous week)*	

Source: American College Health Association. American College Health Association Influenza Like Illnesses (ILI) Surveillance in Colleges and Universities Fall 2009: Weekly College ILI cases reported. Linthicum, MD: American College Health Association; 2009. www.acha.org/ILI_LatestWeek.cfm#chart_state

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